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I, Mario Rausa, can read and write in English and Italian. The attached document is an accurate English translation of Italian patent application No. MI2000A 001719.

16-06-2003
Date

Mario Rausa

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"Lead-frame for semiconductor devices."

* * * * *

DESCRIPTION

The present invention refers to a lead-frame for semiconductor devices, particularly during the encapsulation operation of said devices.

During the molding process of a semiconductor device or an integrated circuit, this is welded to a metal structure or frame called "lead-frame", and has fine blades usually made of copper, or other conductive material for the electric connection.

During a successive phase a mold, the so-called "package", is closed around the integrated circuit by the upper and lower surfaces of the lead-frame and said mold is filled, by injecting means, with some plastic or resinous material, so as to make the body of the integrated circuit package, after the resin has solidified.

The mold must have "air vents", so that it can be completely filled with the plastic material in such a way that air bubbles are prevented from forming inside the plastic material which would prevent the mold from being completely filled.

The air vents are designed so as to let out the air present in the mold to avoid residuals or flashes, nevertheless the presence of these air vents always causes small quantities of resinous material to seep out on the lead-frame external to the mold, resin which forms the so-called "flashes".

The flashes of resinous material are very fragile, possess a weak cohesion with the surface of the lead-frame, and therefore can be easily removed from the lead-frame itself.

The detachment of the flashes from the lead-frame causes a series of problems, for example, that the resin which has become detached can go onto the sensors of the machinery used in phases successive to the molding, causing

undesired halting of the machinery itself with evident degradation of performance and production losses.

Another very important problem occurs during the phase of separation of the integrated circuits from the lead-frame. In fact because of this operation the flashes, which fall and adhere to the terminals (the so-called leads) of the lead-frame, can be treated as contaminating elements and thus entail negative results to the electric tests and also refusal of material by the client.

In view of the state of the technique described, the object of this invention is to increase the adhesion of the flash to the surface of the lead-frame and to diminish the amount of contaminating material on the leads.

According to this invention, said object is reached by means of a lead-frame for semiconductor devices consisting of a frame and a mold, having at least one air vent to let out the resin during the injecting in said mold, said air vent being placed between the upper and lower surface of said frame, said mold forming a package of said integrated circuit, characterised in that said frame provides for a through hole, placed at the outlet of said air vent, so that when the resin has solidified it forms a flash which is more coherent with the surface of said frame.

Thanks to this invention a lead-frame can be made which is capable of preventing loss in production and the formation of contaminating material on the leads.

The characteristics and the advantages of this invention will result evident from the following detailed description of an embodiment thereof, illustrated as non-limiting example in the enclosed drawings, in which:

Figure 1 shows schematically a first embodiment of this invention;

Figure 2 shows a detail of figure 1;

Figure 3 shows a section of figure 2 along the line III-III;

Figure 4 shows the detail of figure 2 after a molding phase;

Figure 5 shows a second embodiment of this invention ;

Figure 6 shows a section of figure 5 along the line VI-VI.

Figure 1 shows schematically a first embodiment of this invention and according to what is illustrated in said Figure a structure 1 called lead-frame can be noted which acts as metal skeleton for a plurality of semiconductor devices (the so-called chips or integrated circuits) 2 which result as being connected to the lead-frame 1 by means of a series of blades or strips of conductive material 3, for example copper. The array of the chips 2 and the contacts 3 makes what is commonly known as "package" 6.

A structure 4 which contacts the plurality of chips 2 can also be noted which has the function of injecting plastic material, for example resin, in all the packages 2.

In a successive phase of the working process, more precisely during the molding phase, also known as "molding", in order that the mold (not shown in the Figure) has to be well filled by the resin injected by the injectors 4, the resin has to have an air vent, thus forming plastic burrs or flashes.

The flashes that are created because of the air vents are very fragile. The diameter of the air vents is approximately 20 μm and they generate flashes approximately 20-25 μm thick, which, having a weak cohesion with the surface of the lead-frame 1, can be easily removed from the lead-frame 1 itself.

The air vents are positioned in a peripheral zone 5 of the package 6, and are theoretically designed so that during the operation of separating said chips 2 from the lead-frame 1, the flashes, produced by the air vents 9 and subject to breakage, do not cause any quality problems.

In reality, the flashes that are formed in a zone 7, called air vent surface, as is shown successively in Figure 2 and Figure 4, and their successive detachment

cause a series of problems, such as undesired halts of the machinery, used in the successive working phase, with production losses.

To obviate this, as is shown in Figure 2, in said zone 7 the Applicant found it advantageous to make a circular recess or through hole 8 with its centre placed on the axis of the air vent 9 at a distance from said air vent 9 exceeding 1 mm, so as to increase the local adhesion of the flashes to the surface of the lead-frame 1.

In fact, a mechanical means has to be created, that is the hole or recess 8, for anchoring the resin to the lead-frame 1.

Also in said figure 2 it can be noted that in addition to hole 8 there is the air vent 9 from which the resin injected by injector 4 seeps, and in addition the blades 3 which contact the chip 2 with the lead-frame 1 can also be noted.

Said hole or recess 8 has a section, which at the most is equal in dimension to that of the air vents 9.

In Figure 3 a section of Figure 2 along the line III-III is shown and it can be noted that the resin 10 seeping from air vent 9 moving in the direction of the arrows, fills hole 8. The thickness of package 2 is approximately 0.7 mm. Once resin 10 is solidified it remains in greater cohesion with the surface of the lead-frame 1 as the appendix of resin 10 that has flowed into hole 8 creates a kind of appendix such that it increases adhesion, as shown successively in Figure 4, during all the successive molding operations.

In Figure 4 the air vent surface zone 7 is shown after the operation of molding has been carried out and in particular the electric connection blades 3 can be noted, flash 10 after the molding operation, that is when the residual (or burr) has solidified.

Flash 10 is firmly anchored to lead-frame 1 and this first embodiment of this invention guarantees a significant drop in production losses and a

disappearance of contaminating material from the leads.

In Figure 5 a second embodiment of this invention is shown and according to what is illustrated in said figure it can be noted that in said zone 7 the Applicant found it advantageous to make an ellipsoidal recess or through hole 11 with its centre positioned on the axis of air vent 9 at a distance from said air vent 9 exceeding approximately 1 mm, so as to increase local adhesion of the flash to the surface of the lead-frame 1.

In this embodiment, the minor axis of ellipsoidal hole 11 is shorter than the diameter of hole 8 and the major axis exceeds the diameter of hole 8, that is the section of hole 11 is smaller than that of air vent 9.

In this way the resin flash which is created, as shown successively in Figure 6, is thicker than that in the first embodiment because the resin has to flow in a greater quantity to completely fill said hole 11.

In fact, as shown in Figure 6 which is the section of Figure 5 along the line VI-VI, when the resin seeps from air vent 9, the thickness of the resin is equal to or exceeds 0.25 mm. Once the resin is solidified there is an upper flash 12 and a lower flash 13 with a thickness which is equal to or greater than 1 mm.

Also in this embodiment of this invention the object is to create a mechanical means for anchorage of the resin to the lead-frame 1, but given the fact that, as said hole 11 has larger dimensions than hole 8 and the quantity of flow of the resin is greater, there is also the formation of a button of resin 13, which can act as a real welding means with lead-frame 1.

The flash, consisting of an upper portion 12 and a lower portion 13, is in cohesion with lead-frame 1 during the successive working phases and in particular this embodiment can be implemented on those lines that make use of resin which has highly fragile, as in the case of transparent resin, which is the resin used in the molding of optic packages.

A solution such as this therefore guarantees high production yields.

CLAIMS

1. Lead-frame for semiconductor devices consisting of a frame and a mold, with at least one air vent from which the resin can seep out of during the injecting phase into said mold, said air vent being positioned between the upper and lower surface of said frame, characterised in that said frame provides a through hole, placed at the outlet of said air vent, so that when the resin has solidified it forms a flash which is in greater coherence with the surface of said frame.

2. Lead-frame according to claim 1, characterised in that said through hole with an ellipsoidal section, having its centre positioned on the axis of said air vent and has the minor diameter dimension of said hole shorter than the diameter of said air vent.

3. Lead-frame according to claim 1, characterised in that said through hole has a circular section with its centre positioned on the axis of said air vent and has the dimension of its diameter fundamentally equal to or shorter than that of said air vent.

4. Lead-frame according to claim 2, characterised in that said air vent by means of said hole with ellipsoidal section gives rise to a flash of resin on the upper surface of said frame and to a flash of resin on the lower surface of said frame, with an overall thickness equal to or exceeding 1 mm.

5. Lead-frame according to claim 2, characterised in that said hole with ellipsoidal section is positioned at a distance of more than 1 mm. from said air vent.

6. Lead-frame according to claim 3, characterised in that said air vent by means of said hole of circular section gives rise to a flash only on the upper surface of said frame, with a thickness ranging between 20-25 μm.

7. Lead-frame according to claim 3, characterised in that said hole of

circular section is positioned at a distance of more than 1 mm. from said air vent.

"Lead-frame for semiconductor devices."

* * * * *

ABSTRACT

This invention relates to a lead-frame for semiconductor devices consisting of a mold with at least one air vent for the resin to seep out of during its injecting said in said mold, said air vent being positioned between the upper and lower surface of said frame, characterised in that said frame provides a through hole, positioned at the outlet of said air vent, so that when the resin has solidified it forms a flash which is in greater coherence with the surface of said frame.

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Milano, 5 June 2000

Re: Filing in Italy of a new patent application for industrial invention entitled: "Lead-frame for semiconductor devices"
Your ref.: 00-AG-016

With this letter we are sending you for approval a copy of the description and the drawings which we intend to annex to the above mentioned patent application.

We also add a power of attorney which shall be sent back to us provided with a stamp and a signature where indicated by pencil.

We look forward to receiving your authorization for the filing of the patent application, or your observations on the matter, and with the occasion we give you our best greetings.

MITTLER & C.
(Fabio Ciceri)

Encls.
description and drawings
power of attorney (by mail)

bc

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Milano, 5 Giugno 2000

Oggetto: Deposito in Italia di una nuova domanda di brevetto per invenzione industriale dal titolo: "Lead-frame per dispositivi a semiconduttore".
Vs. rif.: 00-AG-016

Con la presente Vi trasmettiamo per approvazione una copia della descrizione e dei disegni che proponiamo di allegare alla domanda di brevetto in oggetto.

Uniamo anche una lettera d'incarico che dovrà esserci restituita timbrata e firmata ove indicato a matita.

Rimaniamo in attesa della Vostra autorizzazione al deposito della domanda, o di eventuali osservazioni in merito, e con l'occasione porgiamo i nostri migliori saluti.

MITTLER & C.
(Fabio Ciceri)

All.
descrizione e disegni
lettera d'incarico (per posta)

bc.

Dr. Ing. Enrico Mittler

DESCRIZIONE

dell'invenzione industriale dal titolo:

"Lead-frame per dispositivi a semiconduttore."

a nome: 1. STMicroelectronics s.r.l.

2. STMicroelectronics Sdn. Bhd.

* * * * *

La presente invenzione si riferisce ad un lead-frame per dispositivi a semiconduttore, particolarmente durante l'operazione di incapsulazione di detti dispositivi.

In un processo di stampaggio di un dispositivo a semiconduttore o di un circuito integrato questi è saldato ad una struttura metallica o telaio chiamato "lead-frame", ed ha sottili lamelle generalmente costituite da rame, o altro materiale conduttivo per il collegamento elettrico.

In una fase successiva uno stampo, il cosiddetto "package", viene chiuso attorno al circuito integrato dalla superficie superiore ed inferiore del lead-frame e detto stampo è riempito, tramite mezzi di iniezione, con del materiale plastico o resinoso, in modo tale da realizzare il corpo dell'involucro del circuito integrato, dopo che la resina si è solidificata.

Lo stampo deve possedere degli sfoghi d'aria, i cosiddetti "air vent", perché possa essere riempito completamente con il materiale plastico, così che sia possibile prevenire la formazione di bolle d'aria all'interno del materiale plastico, evitando, dunque, l'incompleto riempimento dello stampo stesso.

Gli air vent sono progettati per fare fuoriuscire l'aria presente nello stampo così da evitare residui o bave di trafilazione, tuttavia la presenza di questi air vent comporta sempre la fuoriuscita di piccole quantità di materiale

resinoso sul lead-frame esterno allo stampo, resina che forma i cosiddetti "flash".

I flash di materiale resinoso sono molto fragili e possiedono una debole coesione con la superficie del lead-frame e pertanto sono facilmente rimovibili dal lead-frame stesso.

Il distacco dei flash dal lead-frame comporta una serie di problemi quali ad esempio che la resina staccatasi possa finire sui sensori di macchinari utilizzati in fase successive allo stampaggio comportando arresti indesiderati dei macchinari stessi con evidenti degradazioni delle prestazioni e perdite di produzione.

Un altro problema molto importante avviene durante la fase di separazione dei circuiti integrati dal lead-frame. Infatti a causa di questa operazione i flash cadendo ed incollandosi ai terminali (i cosiddetti "lead") del lead-frame, possono essere trattati come elementi inquinanti e, dunque, comportare esiti negativi ai test elettrici ed anche a rifiuti di materiale da parte del cliente.

In vista dello stato della tecnica descritto, scopo della presente invenzione è quello di aumentare l'adesione dei flash alla superficie del lead-frame e di diminuire la quantità di materiale inquinante sui lead.

In accordo con la presente invenzione, tale scopo viene raggiunto mediante un telaio per dispositivi a semiconduttore comprendente uno stampo, avente almeno uno sfogo d'aria per la fuoriuscita di resina durante l'iniezione della stessa in detto stampo, detto sfogo d'aria essendo posto tra la superficie superiore ed inferiore di detto telaio, detto stampo realizzando un involucro di detto circuito integrato, caratterizzato dal fatto che detto telaio

prevede un foro passante, posto in corrispondenza dell'uscita di detto sfogo d'aria, in modo tale che la resina una volta solidificatesi formi un flash più coeso con la superficie di detto telaio.

Grazie alla presente invenzione è possibile realizzare un lead-frame in grado di evitare perdite di produzione e la presenza di materiale inquinante sui lead.

Le caratteristiche ed i vantaggi della presente invenzione risulteranno evidenti dalla seguente descrizione dettagliata di una sua forma di realizzazione pratica, illustrata a titolo di esempio non limitativo negli uniti disegni, nei quali:

la figura 1 mostra in maniera schematica una prima forma realizzativa della presente invenzione;

la figura 2 mostra un dettaglio della figura 1;

la figura 3 mostra una sezione della figura 2 lungo la linea III-III;

la figura 4 mostra il particolare di figura 2 dopo una fase di stampaggio;

la figura 5 mostra una seconda forma realizzativa della presente invenzione;

la figura 6 mostra una sezione della figura 5 lungo la linea VI-VI.

In figura 1 è mostrata in maniera schematica una prima forma realizzativa della presente invenzione e secondo quanto illustrato in tale figura si nota una struttura 1 chiamata lead-frame che funge da scheletro metallico per una pluralità di dispositivi a semiconduttore (i cosiddetti chip o circuiti integrati) 2 che risultano essere connessi al lead-frame 1 per mezzo di una serie di lamelle o strisce di materiale conduttivo 3, ad esempio rame. L'insieme dei chip 2 e dei contatti 3 realizza quello che è comunemente noto come "package" 6.

Si nota anche una struttura 4 che contatta la pluralità di chip 2 avente la funzione di iniettare materiale plastico, ad esempio resina, in tutti i package 2.

In una fase successiva del processo di lavorazione, più precisamente durante la fase di stampaggio, chiamata anche "molding", è necessario per ottenere un buon riempimento dello stampo (non mostrato in figura) da parte della resina iniettata dagli iniettori 4, che la resina abbia uno sfogo di uscita, i cosiddetti "air vent", formando così delle bave di plastica o residui di trafilazione o flash.

I flash che si creano a causa degli air vent sono molto fragili. Gli air vent hanno un diametro pari a circa 20μm e generano flash dello spessore di circa 20-25μm, aventi una debole coesione con la superficie del lead-frame 1 e pertanto facilmente rimovibili dal lead-frame 1 stessa.

Gli air vent sono posti in una zona periferica 5 del package 6, e sono progettati teoricamente in maniera tale che durante un'operazione di separazione di detti chip 2 dal lead-frame 1, i flash, prodotti dagli air vent 9 e soggetti a rottura, non causino problemi di qualità.

In realtà i flash che si formano in una zona 7, chiamata superficie dell'air vent, come mostrato successivamente in figura 2 e figura 4, ed il loro successivo distacco causano una serie di problemi di qualità del prodotto quali, ad esempio, arresti indesiderati dei macchinari, utilizzati in fase successive di lavorazione, con perdite di produzione.

Per ovviare a ciò, come mostrato in figura 2, in detta zona 7 la Richiedente ha trovato vantaggioso praticare un recesso o un foro passante 8 di forma circolare avente il proprio centro posto sull'asse dell'air vent 9 ad una distanza da detto air vent 9 superiore a 1mm, in modo tale da aumentare

l'adesione locale dei flash alla superficie del lead-frame 1.

Si vuole in praticare creare un mezzo meccanico di ancoraggio, cioè il foro o recesso 8, al lead-frame 1 per la resina.

Si nota inoltre in tale figura 2 che oltre al foro 8 vi è l'air vent 9 da cui fuoriesce la resina iniettata dall'iniettore 4, ed inoltre si notano anche le lamelle 3 che contattano il chip 2 con il lead-frame 1.

Detto foro o recesso 8 ha una sezione al massimo di pari dimensione rispetto a quella degli air vent 9.

In figura 3 è mostrata una sezione della figura 2 lungo la linea III-III e si nota che la resina 10 fuoriuscita dall'air vent 9 muovendosi nella direzione delle frecce, riempie il foro 8. Una volta che la resina 10 si solidifica questa rimane più coesa alla superficie del lead-frame 1 in quanto l'appendice di resina 10 fluita nel foro 8 crea una sorta di appendice tale da aumentare l'adesione, come mostrato successivamente in figura 4, durante tutte le operazioni di lavoro successive di stampaggio.

In figura 4 è mostrata la zona superficiale dell'air vent 7 dopo che è stata effettuata l'operazione di stampaggio ed in particolare si possono notare le lamelle di collegamento elettrico 3, il flash 10 dopo l'operazione di stampaggio, cioè quando il residuo di trafilazione (o bava) si è solidificato.

Il flash 10 è saldamente ancorato alla lead-frame 1 e questa prima forma realizzativa della presente invenzione garantisce un drastico calo di perdite di produzione ed una scomparsa di materiale inquinante dai lead.

In figura 5 è mostrato una seconda forma realizzativa della presente invenzione e secondo quanto illustrato in tale figura si nota che in detta zona 7 la Richiedente ha trovato vantaggioso praticare un recesso o un foro passante

11 di forma ellissoidale avente il proprio centro posto sull'asse dell'air vent 9 ad una distanza da detto air vent 9 superiore a circa 1mm, in modo tale da aumentare l'adesione locale dei flash alla superficie del lead-frame 1.

In questa forma realizzativa il foro di forma ellissoidale 11 ha l'asse minore inferiore al diametro del foro 8 e ha l'asse maggiore superiore al diametro del foro 8, cioè il foro 11 ha una sezione inferiore a quello dell'air vent 9.

In questo modo il flash di resina che si viene a creare, come mostrato successivamente in figura 6, è più spesso rispetto alla prima forma realizzativa perché la resina deve fluire in quantità superiore per riempire completamente detto foro 11.

Infatti, come mostrato in figura 6 che è la sezione della figura 5 lungo la linea VI-VI, una volta che la resina si è solidificata si ha un flash superiore 12 ed uno inferiore 13 con uno spessore pari o maggiore a 0,025mm.

Anche in questa forma realizzativa della presente invenzione lo scopo è quello di creare un mezzo meccanico di ancoraggio al lead-frame 1 per la resina, ma dato che detto foro 11 ha dimensioni maggiori rispetto al foro 8 la resina fluisce è in quantità superiore si ha anche la formazione di bottone di resina 13 in grado di fungere da vero o proprio mezzo saldante con la lead-frame 1.

Il flash, costituito da una porzione superiore 12 ed inferiore 13, è coesa durante tutte le fasi di lavoro successive al lead-frame 1 ed in particolare questa forma realizzativa può essere implementata su quelle linee che fanno uso di resina con caratteristiche di fragilità elevata, come nel caso di resina trasparente, che è la resina che si adotta nello stampaggio di package ottici.

Una soluzione siffatta garantisce, dunque, elevate rese di produzione,

Dr. Ing. Enrico Mittler

RIVENDICAZIONI

1. Lead-frame per dispositivi a semiconduttore comprendente un telaio (1) per dispositivi a semioonduttore (2) comprendente uno stampo, avente almeno uno sfogo d'aria (9) per la fuoriuscita di resina durante l'iniezione della stessa in detto stampo, detto sfogo d'aria (9) essendo posto tra la superficie superiore ed inferiore di detto telaio (1), caratterizzato dal fatto che detto telaio (1) prevede un foro passante (8, 11), posto in corrispondenza dell'uscita di detto sfogo d'aria (9), in modo tale che la resina una volta solidificatesi formi un flash (10, 12, 13) più coeso con la superficie di detto telaio (1).

2. Lead-frame secondo la rivendicazione 1, caratterizzato dal fatto che detto foro passante (11) è di sezione ellissoidale, avente il proprio centro (14) posto sull'asse (15) di detto sfogo d'aria (9) ed avendo la dimensione del diametro minore di detto foro (11) inferiore rispetto al diametro di detto sfogo (9).

3. Lead-frame secondo la rivendicazione 1, caratterizzato dal fatto che detto foro passante (8) è di sezione circolare avente il proprio centro (16) posto sull'asse (15) di detto sfogo d'aria (9) ed avendo la dimensione del diametro sostanzialmente uguale o inferiore rispetto a detto sfogo (9).

4. Lead-frame secondo la rivendicazione 2, caratterizzato dal fatto che detto sfogo (9) per mezzo di detto foro (11) di sezione ellissoidale dà luogo ad un flash (12) di resina sulla superficie superiore di detto telaio (1) ed ad un flash (13) di resina sulla superficie inferiore di detto telaio (1), aventi uno spessore complessivo superiore ad 0,025mm.

5. Lead-frame secondo la rivendicazione 2, caratterizzato dal fatto che

detto foro (11) di sezione ellissoidale è posto ad una distanza da detto sfogo (9) superiore ad 1mm.

6. Lead-frame secondo la rivendicazione 3, caratterizzato dal fatto che detto sfogo (9) per mezzo ti detto foro (8) di sezione circolare dà luogo ad un flash (10) solamente sulla superficie superiore di detto telaio (1), avente uno spessore compreso in un intervallo di valori tra 20-25 μm.

7. Lead-frame secondo la rivendicazione 3, caratterizzato dal fatto che detto foro (8) di sezione circolare è posto ad una distanza da detto sfogo (9) superiore ad 1mm.

Dr. Ing. Enrico Mittler

Dr. Ing. Enrico Mittler

RIASSUNTO

La presente invenzione concerne un telaio (1) per dispositivi a semiconduttore comprendente uno stampo avente almeno uno sfogo d'aria (9) per la fuoriuscita di resina durante l'iniezione della stessa in detto stampo, detto sfogo d'aria (9) essendo posto tra la superficie superiore ed inferiore di detto telaio (1), caratterizzato dal fatto che detto telaio (1) prevede un foro passante (8, 11), posto in corrispondenza dell'uscita di detto sfogo d'aria (9), in modo tale che la resina una volta solidificatesi formi un flash (10, 12, 13) più coeso con la superficie di detto telaio (1). (Figura 4).

Dr. Ing. Enrico Mittler

DESCRIPTION

of the industrial invention entitled:

"Lead-frame for semiconductor devices."

in the name of: 1. STMicroelectronics s.r.l.

2. STMicroelectronics Sdn. Bhd.

* * * * *

The present invention refers to a lead-frame for semiconductor devices, particularly during the encapsulation operation of said devices.

During the molding process of a semiconductor device or an integrated circuit, this is welded to a metal structure or frame called "lead-frame", and has fine blades usually made of copper, or other conductive material for the electric connection.

During a successive phase a mold, the so-called "package", is closed around the integrated circuit by the upper and lower surfaces of the lead-frame and said mold is filled, by injecting means, with some plastic or resinous material, so as to make the body of the integrated circuit package, after the resin has solidified.

The mold must have "air vents", so that it can be completely filled with the plastic material in such a way that air bubbles are prevented from forming inside the plastic material which would prevent the mold from being completely filled.

The air vents are designed so as to let out the air present in the mold to avoid residuals or flashes, nevertheless the presence of these air vents always causes small quantities of resinous material to seep out on the lead-frame external to the mold, resin which forms the so-called "flashes".

The flashes of resinous material are very fragile, possess a weak cohesion with the surface of the lead-frame, and therefore can be easily removed from the lead-frame itself.

The detachment of the flashes from the lead-frame causes a series of problems, for example, that the resin which has become detached can go onto the sensors of the machinery used in phases successive to the molding, causing undesired halting of the machinery itself with evident degradation of performance and production losses.

Another very important problem occurs during the phase of separation of the integrated circuits from the lead-frame. In fact because of this operation the flashes, which fall and adhere to the terminals (the so-called leads) of the lead-frame, can be treated as contaminating elements and thus entail negative results to the electric tests and also refusal of material by the client.

In view of the state of the technique described, the object of this invention is to increase the adhesion of the flash to the surface of the lead-frame and to diminish the amount of contaminating material on the leads.

According to this invention, said object is reached by means of a lead-frame for semiconductor devices comprising a mold, having at least one air vent to let out the resin during the injecting in said mold, said air vent being placed between the upper and lower surface of said frame, said mold forming a package of said integrated circuit, characterised in that said frame provides for a through hole, placed at the outlet of said air vent, so that when the resin has solidified it forms a flash which is more coherent with the surface of said frame.

Thanks to this invention a lead-frame can be made which is capable of

preventing loss in production and the formation of contaminating material on the leads.

The characteristics and the advantages of this invention will result evident from the following detailed description of an embodiment thereof, illustrated as non-limiting example in the enclosed drawings, in which:

Figure 1 shows schematically a first embodiment of this invention;

Figure 2 shows a detail of figure 1;

Figure 3 shows a section of figure 2 along the line III-III;

Figure 4 shows the detail of figure 2 after a molding phase;

Figure 5 shows a second embodiment of this invention ;

Figure 6 shows a section of figure 5 along the line VI-VI.

Figure 1 shows schematically a first embodiment of this invention and according to what is illustrated in said Figure a structure 1 called lead-frame can be noted which acts as metal skeleton for a plurality of semiconductor devices (the so-called chips or integrated circuits) 2 which result as being connected to the lead-frame 1 by means of a series of blades or strips of conductive material 3, for example copper. The array of the chips 2 and the contacts 3 makes what is commonly known as "package" 6.

A structure 4 which contacts the plurality of chips 2 can also be noted which has the function of injecting plastic material, for example resin, in all the packages 2.

In a successive phase of the working process, more precisely during the molding phase, also known as "molding", in order that the mold (not shown in the Figure) has to be well filled by the resin injected by the injectors 4, the resin has to have an air vent, thus forming plastic burrs or flashes.

The flashes that are created because of the air vents are very fragile. The diameter of the air vents is approximately 20 μm and they generate flashes approximately 20-25 μm thick, which, having a weak cohesion with the surface of the lead-frame 1, can be easily removed from the lead-frame 1 itself.

The air vents are positioned in a peripheral zone 5 of the package 6, and are theoretically designed so that during the operation of separating said chips 2 from the lead-frame 1, the flashes, produced by the air vents 9 and subject to breakage, do not cause any quality problems.

In reality, the flashes that are formed in a zone 7, called air vent surface, as is shown successively in Figure 2 and Figure 4, and their successive detachment cause a series of problems, such as undesired halts of the machinery, used in the successive working phase, with production losses.

To obviate this, as is shown in Figure 2, in said zone 7 the Applicant found it advantageous to make a circular recess or through hole 8 with its centre placed on the axis of the air vent 9 at a distance from said air vent 9 exceeding 1 mm, so as to increase the local adhesion of the flashes to the surface of the lead-frame 1.

In fact, a mechanical means has to be created, that is the hole or recess 8, for anchoring the resin to the lead-frame 1.

Also in said figure 2 it can be noted that in addition to hole 8 there is the air vent 9 from which the resin injected by injector 4 seeps, and in addition the blades 3 which contact the chip 2 with the lead-frame 1 can also be noted.

Said hole or recess 8 has a section, which at the most is equal in dimension to that of the air vents 9.

In Figure 3 a section of Figure 2 along the line III-III is shown and it can be noted that the resin 10 seeping from air vent 9 moving in the direction of the arrows, fills hole 8. Once resin 10 is solidified it remains in greater cohesion with the surface of the lead-frame 1 as the appendix of resin 10 that has flowed into hole 8 creates a kind of appendix such that it increases adhesion, as shown successively in Figure 4, during all the successive molding operations.

In Figure 4 the air vent surface zone 7 is shown after the operation of molding has been carried out and in particular the electric connection blades 3 can be noted, flash 10 after the molding operation, that is when the residual (or burr) has solidified.

Flash 10 is firmly anchored to lead-frame 1 and this first embodiment of this invention guarantees a significant drop in production losses and a disappearance of contaminating material from the leads.

In Figure 5 a second embodiment of this invention is shown and according to what is illustrated in said figure it can be noted that in said zone 7 the Applicant found it advantageous to make an ellipsoidal recess or through hole 11 with its centre positioned on the axis of air vent 9 at a distance from said air vent 9 exceeding approximately 1 mm, so as to increase local adhesion of the flash to the surface of the lead-frame 1.

In this embodiment, the minor axis of ellipsoidal hole 11 is shorter than the diameter of hole 8 and the major axis exceeds the diameter of hole 8, that is the section of hole 11 is smaller than that of air vent 9.

In this way the resin flash which is created, as shown successively in Figure 6, is thicker than that in the first embodiment because the resin has to

flow in a greater quantity to completely fill said hole 11.

In fact, as shown in Figure 6 which is the section of Figure 5 along the line VI-VI, once the resin is solidified there is an upper flash 12 and a lower flash 13 with a thickness which is equal to or greater than 0.025 mm.

Also in this embodiment of this invention the object is to create a mechanical means for anchorage of the resin to the lead-frame 1, but given the fact that, as said hole 11 has larger dimensions than hole 8 and the quantity of flow of the resin is greater, there is also the formation of a button of resin 13, which can act as a real welding means with lead-frame 1.

The flash, consisting of an upper portion 12 and a lower portion 13, is in cohesion with lead-frame 1 during the successive working phases and in particular this embodiment can be implemented on those lines that make use of resin which has highly fragile, as in the case of transparent resin, which is the resin used in the molding of optic packages.

A solution such as this therefore guarantees high production yields.

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CLAIMS

1. Lead-frame for semiconductor devices consisting of a lead-frame (1) for semiconductor devices (2) comprising a mold, with at least one air vent (9) from which the resin can seep out of during the injecting phase into said mold, said air vent (9) being positioned between the upper and lower surface of said frame (1), characterised in that said frame (1) provides a through hole (8, 11), placed at the outlet of said air vent (9), so that when the resin has solidified it forms a flash (10, 12, 13) which is in greater coherence with the surface of said frame (1).

2. Lead-frame according to claim 1, characterised in that said through hole (11) with an ellipsoidal section, having its centre (14) positioned on the axis (15) of said air vent (9) and has the minor diameter dimension of said hole (11) shorter than the diameter of said air vent (9).

3. Lead-frame according to claim 1, characterised in that said through hole (8) has a circular section with its centre (16) positioned on the axis (15) of said air vent (9) and has the dimension of its diameter fundamentally equal to or shorter than that of said air vent (9).

4. Lead-frame according to claim 2, characterised in that said air vent (9) by means of said hole (11) with ellipsoidal section gives rise to a flash (12) of resin on the upper surface of said frame (1) and to a flash (13) of resin on the lower surface of said frame (1), with an overall thickness exceeding 0.025mm.

5. Lead-frame according to claim 2, characterised in that said hole (11) with ellipsoidal section is positioned at a distance of more than 1 mm. from said air vent (9).

Dr. Ing. Enrico Mittler

6. Lead-frame according to claim 3, characterised in that said air vent (9) by means of said hole (8) of circular section gives rise to a flash (10) only on the upper surface of said frame (1), with a thickness ranging between 20-25 μm.

7. Lead-frame according to claim 3, characterised in that said hole (8) of circular section is positioned at a distance of more than 1 mm. from said air vent (9).

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ABSTRACT

This invention relates to a lead-frame (1) for semiconductor devices comprising a mold with at least one air vent (9) for the resin to seep out of during its injecting said in said mold, said air vent (9) being positioned between the upper and lower surface of said frame (1), characterised in that said frame (1) provides a through hole (8, 11), positioned at the outlet of said air vent (9), so that when the resin has solidified it forms a flash (10, 12, 13) which is in greater coherence with the surface of said frame (1). (Figure 4).

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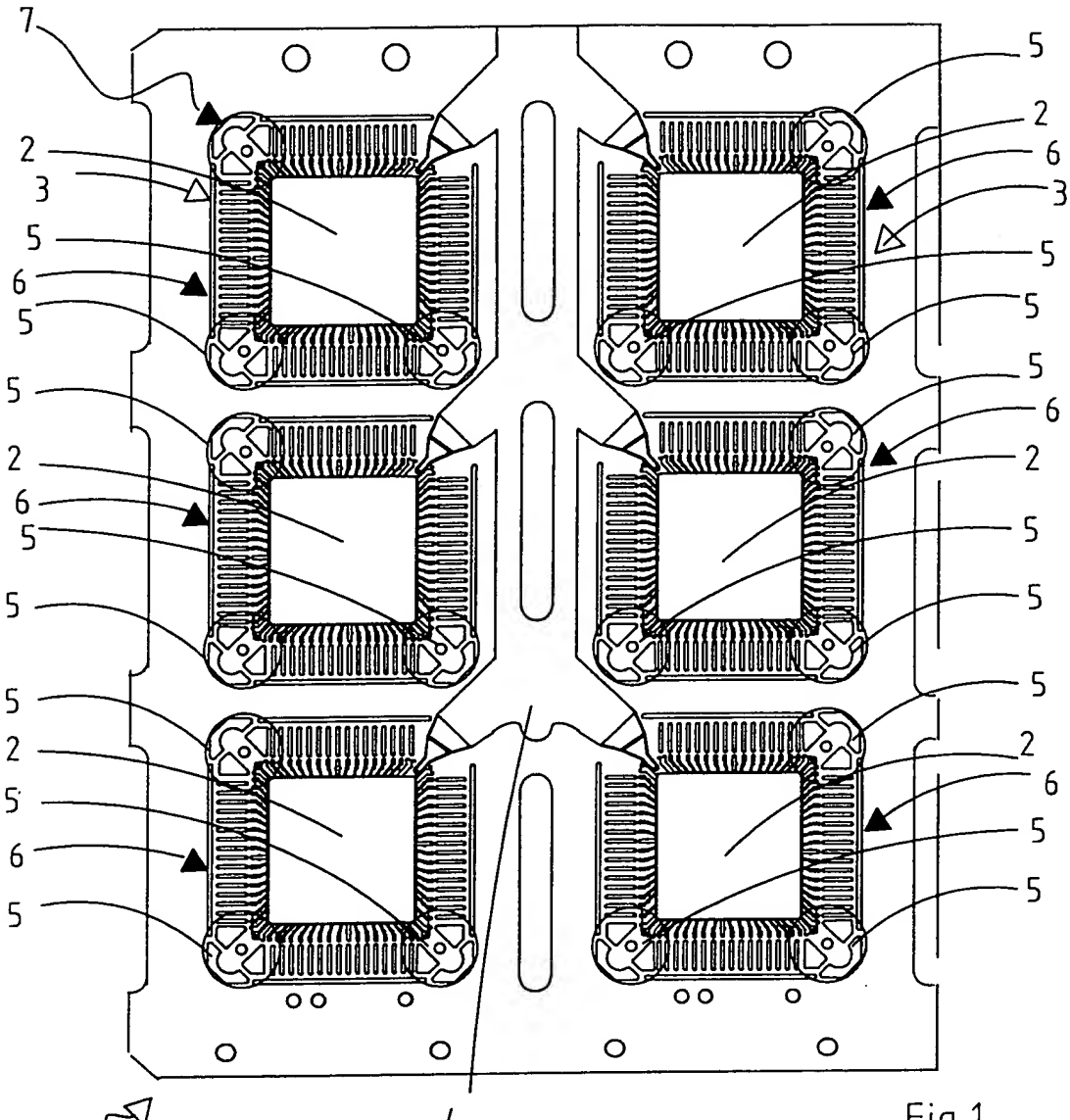

Fig.1

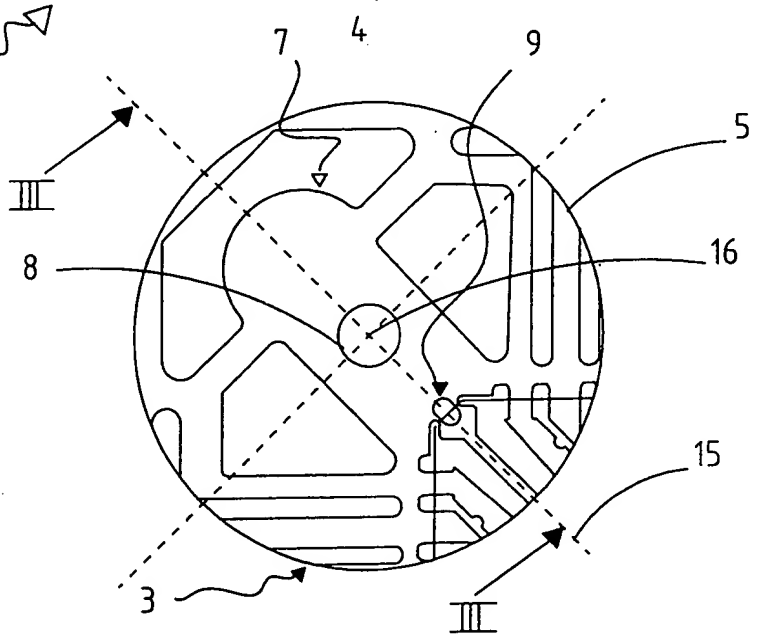

Fig.2

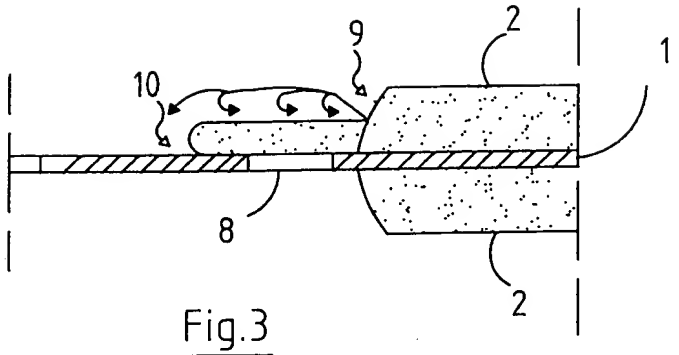

Fig.3

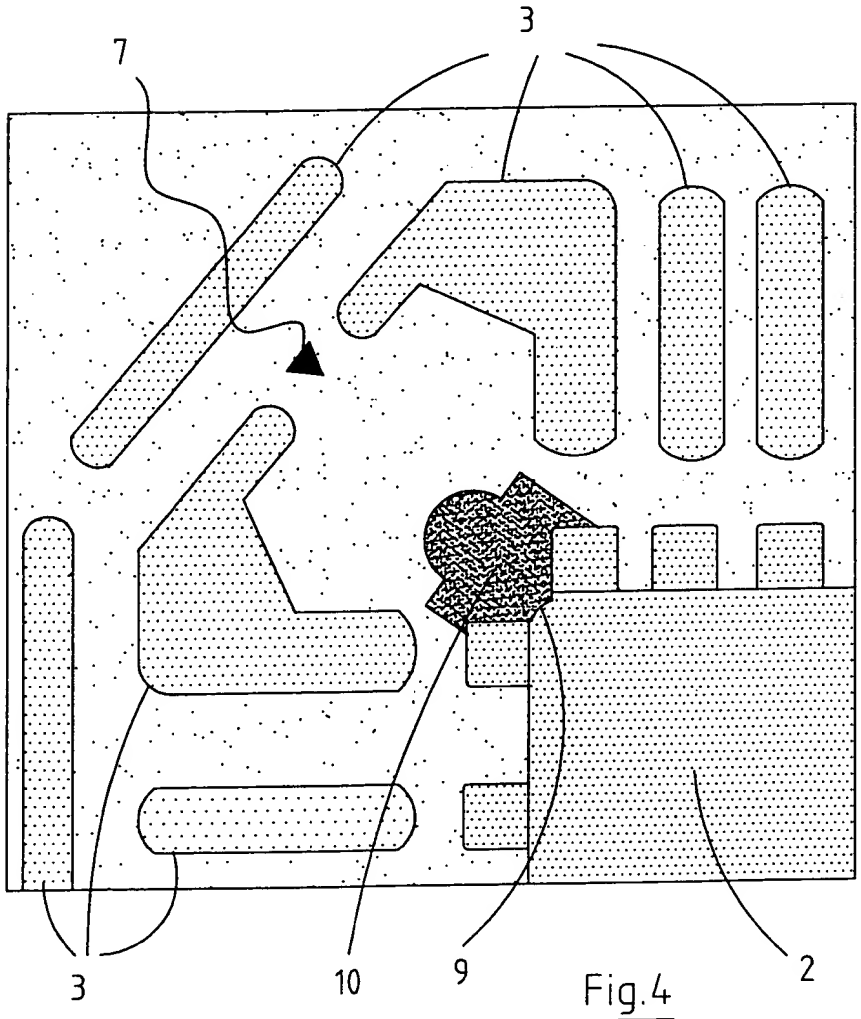

Fig.4

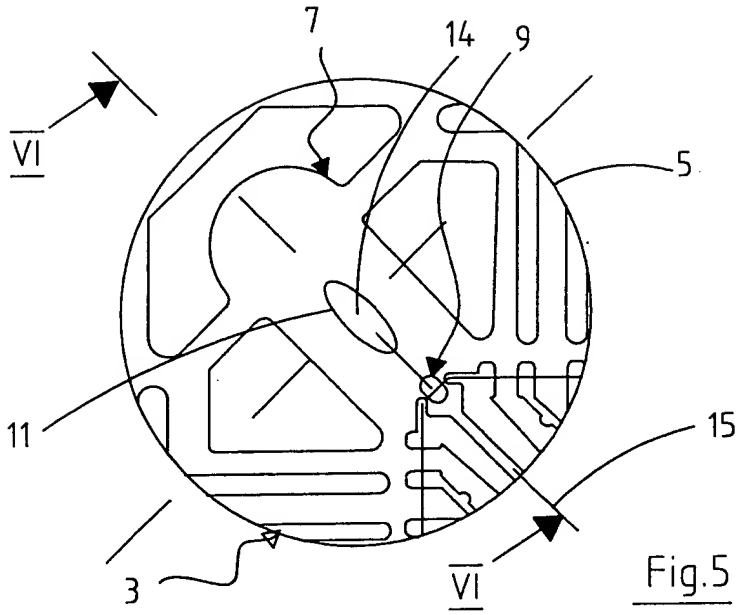

Fig.5

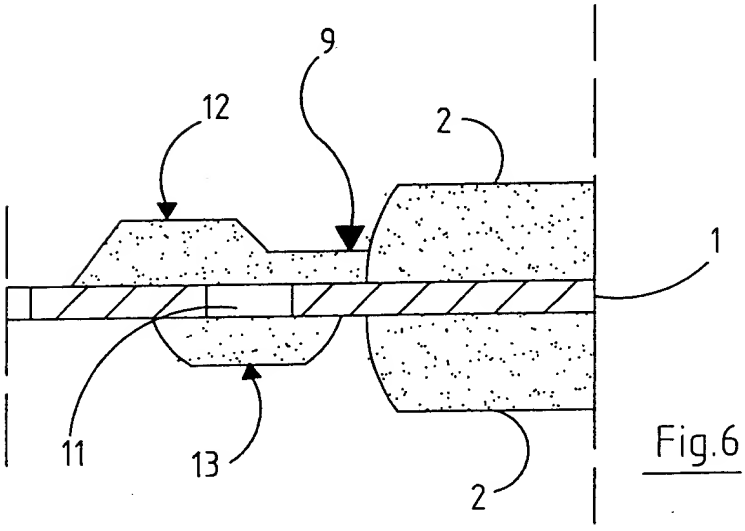

Fig.6